Frequently Asked Questions

Help me understand the basics of cellular technology. How does my phone send and receive information; and what exactly is the wireless spectrum that I hear so much about?

a. **All devices that communicate or share information wirelessly are just radios that use antennas and computer chips to transmit and receive information.** This means that cellphones essentially function the same way as any wireless device, ranging from garage door openers to baby monitors or cordless phones. A key difference is in the type of information that can be transmitted, the range in which individual wireless devices can communicate, and the speed at which these devices transmit information.

b. **A cellular network is designed to provide wireless coverage for mobile devices without any discontinuity** in the radio connection. Service providers, such as Verizon and AT&T, make use of their cellular networks to provide wireless service to their customers almost anywhere in the country.

a. **Cellphones have more powerful computer chips and bigger antennas than most household wireless devices, allowing them to process different data streams such as voice, photos and video.** To communicate information over long distances, cell towers (or base stations) collect and send data from cell phones to the Internet through a cellular core network. Cellular data moves to the core network on cables called the backhaul. The core network then delivers data from hundreds of cell towers to the appropriate location and user.

b. **To avoid interfering with one another, all wireless technology including phones, televisions and radios are assigned a specific set of frequencies to transmit and receive information.** For instance, garage door openers operate at around 40 megahertz, while the 700 megahertz bands are used in U.S. to provide a large part of the current cellular service. The range of all available frequencies is called the wireless spectrum. Spectrum is a finite resource governed and administered by the National Telecommunication and Information Administration (NTIA) and the Federal Communications Commission (FCC).

c. **As technology has evolved, more and more devices are utilizing the available wireless spectrum and most experts predict a shortage** (Frenzell, 2020). A spectrum shortage decreases the reliability of wireless communication leading to dropped, delayed or blocked signals, bad video streaming and lack of connectivity. This is particularly concerning for wireless systems that require constant connectivity such as navigation systems, drones or emergency communication systems.

d. **Due to the ever-evolving nature of technology and a possible spectrum shortage, the wireless industry has continually evolved the capabilities of wireless devices to more efficiently send and receive information.** This is where 5G comes into play.

What exactly is 5G? How is 5G different than previous generations of cellular technology? Why is it such a big deal?

a. **Fifth generation – or 5G – is the next evolution of cellular technology that promises transformational change to current networks.** This includes improvements in phones and computers, as well as the infrastructure and capabilities supporting mobile broadband communication.

b. **There are some major differences between 5G and previous cellular generations like 2G, 3G and 4G. Two major differences are faster connection time and significantly higher data speeds.** With these improvements, just about every electronic device will incorporate wireless communication functionality, and many will utilize 5G to communicate (Lee, 2019; CISCO, 2016).

c. **5G devices are also "spectrum agile" meaning they can add unused shared or unlicensed spectrum from another band to handle additional data.** Primarily, 5G has the capability to simultaneously share the same frequency bandwidth as 4G LTE phones and to allocate that bandwidth based on user demand. This means 5G devices will be significantly faster and have faster response times (also called lower latency), when processing data than previous generations.

d. **5G devices will use millimeter wave technology that allows for significantly smaller components and antennas.** The cell towers will be much smaller too. These smaller cell sites and smaller antennas will augment existing large cell towers and help alleviate cellular congestion in crowded areas like office buildings, sports stadiums or during special events where large groups of people gather and use many simultaneously connected devices.

e. **Years from now when 5G is fully deployed, billions of mobile devices and other technologies are likely to become 5G-enabled (CISCO, 2019).** The proliferation of new wireless-connected devices is often called the Internet of Things (IoT). Because cellular connectivity already exists virtually everywhere, 5G's speed and reliability improvements will also enable the use of wireless systems in places where cable internet service or WiFi isn't always feasible, like inside autonomous vehicles, drones, at remote telemedicine locations, or to administer distance learning programs in rural America.

What are some of the advantages of 5G technology and how will it be used?

a. **The biggest advantage of 5G technology is speed, fast response (low latency), and the ability to support many more devices than is possible today.** When fully deployed, 5G could rival or surpass cable speeds. It will also reduce latency; the annoying lag or buffering that occurs when your phone, tablet or other electronic device waits to start receiving incoming data.

What are some of the challenges of 5G technology?

a. **A national 5G network doesn't exist yet.** This means that despite the hype, most people don't have access to 5G service. This is changing quickly; however, as major cellular providers and technology companies embrace and invest in 5G infrastructure.
b. **Security is also a significant challenge for 5G technology**. With an expected increase in devices utilizing 5G communication, more attention and research needs to examine ways to secure the flow of data to and from 5G-enabled devices. This is an area of research at Idaho National Laboratory.
c. **How do we make sure new 5G devices work right and keep our information secure?** The number of devices connected to 5G will increase significantly over time. These will vary from connected cars and drones to cyber-physical control devices. 5G networks must be designed with security from the very beginning to prevent any disruptions to the critical services provided by these devices. Validation of 5G interoperability, frequency usage and security policies are also core capability areas being developed by Idaho National Laboratory.

What is the difference between 5G and WiFi?

a. **The biggest difference is that 5G is a cellular technology that supports mobility using licensed bands, ensuring wireless connectivity nationwide.** While WiFi relies on unlicensed spectrum available to anyone for wireless coverage within a limited area (Hill, 2019).

Are there health effects associated with 5G technology? Should people worry about 5G?

a. **Numerous studies have been conducted on the health effects of radio frequency transmission. Most scientists reject claims that frequency waves emitted from wireless technology lead to long-term consequences** (Broad, 2019).

Is 5G available now? When will it be deployed nationwide?

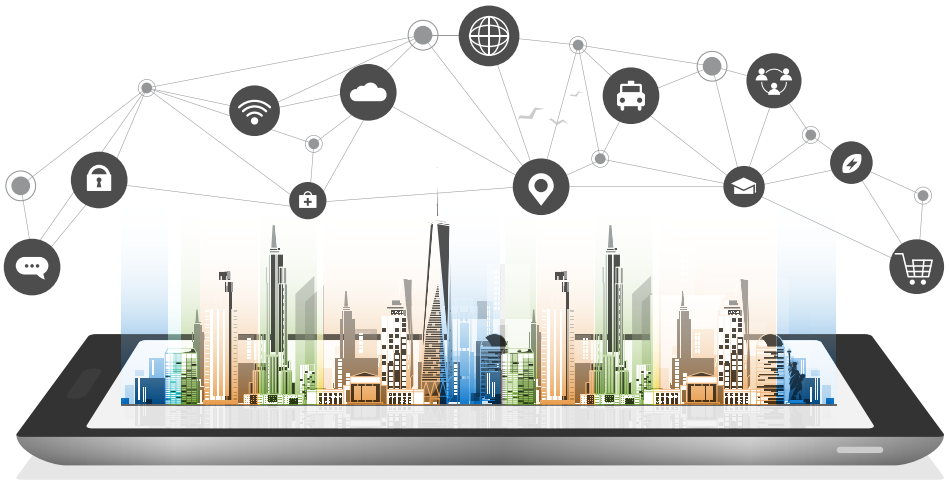
a. **5G is currently limited to select cities and some venues like sports stadiums.** For instance, Verizon offered 5G service during Superbowl LIV inside the stadium. However, every major cellphone provider is investing heavily in the infrastructure to support 5G deployment. Nationwide availability is still several years away and will be phased in incrementally.

How much will 5G cost to implement?

a. **Early projections put the total cost of standing up global 5G infrastructure at close to $3 trillion** (Busvine, 2019). Over several years, it's likely that billions will be spent in the U.S. alone.

How is Idaho National Laboratory involved in 5G?

a. **For more than 20 years, INL has conducted research, testing and training on wireless technology and systems, including wireless radios, cellphones and satellite technology.** We own, operate and manage a best-in-class external Wireless Test Bed that includes 2G, 3G and 4G technology, including fixed and mobile towers, relay stations, network and switch gear. Initial security testing of 5G devices will begin in June 2020, and the initial, nonstandalone, 5G external range capability will be operational in November 2020. INL plans to add new 5G technology as it becomes available.
b. **The laboratory has developed several award-winning and patented technologies that work to improve wireless security and increase efficient use of spectrum.** One of these technologies is under consideration for incorporation in national 5G standards, and another will help monitor and protect 5G frequency usage.
c. **In 2019, INL launched a Wireless Security Institute to lead national research efforts to develop technology solutions to enhance 5G security.** The first of many workshops and conversations to address wireless security standards was hosted by INL in Salt Lake City on Feb. 27, 2020.



INL Idaho National Laboratory

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